



INVESTOR IN PEOPLE

The Patent Office  
Concept House  
Cardiff Road  
Newport  
South Wales  
NP10 8QQ

## BEST AVAILABLE COPY

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

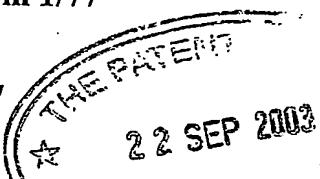
In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

In accordance with the rules, the words "public limited company" may be replaced by p.l.c., plc, P.L.C. or PLC.

Re-registration under the Companies Act does not constitute a new legal entity but merely subjects the company to certain additional company law rules.

Signed

Dated 2 November 2004



1/77

## Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

 Concept House  
 Cardiff Road  
 Newport  
 South Wales NP10 8QQ

1. Your reference	AJF/P64228/000		
2. Patent application number <i>(The Patent Office will fill in this)</i>	22 SEP 2003 22SEP03 1639027-1 D02682 P01/7700 0.00-0322132.2		
3. Full name, address and postcode of the or of each applicant <i>(underline all surnames)</i>  Patents ADP number <i>(if you know it)</i> If the applicant is a corporate body, give the country/state of its incorporation	SYNAD TECHNOLOGIES LIMITED 1650 ARLINGTON BUSINESS PARK THEALE READING BERKSHIRE RG7 4SA  8268690004 UNITED KINGDOM		
4. Title of the invention	METHOD OF DATA HANDLING IN A WLAN		
5. Name of your agent <i>(if you have one)</i>  "Address for service" in the United Kingdom to which all correspondence should be sent <i>(including the postcode)</i>  Patents ADP number <i>(if you know it)</i>	BOULT WADE TENNANT  VERULAM GARDENS 70 GRAY'S INN ROAD LONDON WC1X 8BT  42001 ✓		
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and <i>(if you know it)</i> the or each application number	Country	Priority application number <i>(if you know it)</i>	Date of filing <i>(day/month/year)</i>
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application		Date of filing <i>(day / month / year)</i>
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? <i>(Answer 'Yes' if:</i> a) <i>any applicant named in part 3 is not an inventor, or</i> b) <i>there is an inventor who is not named as an applicant,</i> <i>or</i> c) <i>any named applicant is a corporate body.</i> <i>See note (d)</i>	YES		

Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form 0

Description 9

Claim(s) 3

Abstract 0

Drawing(s) 2

10. If you are also filing any of the following, state how many against each item.

Priority documents 0

Translations of priority documents 0

Statement of inventorship and right to grant of a patent (Patents Form 7/77) 0

Request for preliminary examination and search (Patents Form 9/77) 0

Request for substantive examination (Patents Form 10/77) 0

Any other documents (Please specify) 0

I/We request the grant of a patent on the basis of this application.

Signature

Date

22 September 2003

11. Name and daytime telephone number of person to contact in the United Kingdom

Dr. Alex Frost  
020 7430 7500

**Warning**

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

**Notes**

- a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 01645 500505.
- b) Write your answers in capital letters using black ink or you may type them.
- c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.
- d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.
- e) Once you have filled in the form you must remember to sign and date it.
- f) For details of the fee and ways to pay please contact the Patent Office.

Method of Data Handling in a WLAN

This invention relates to a modified method of data transmission and receipt acknowledgement in a 5 Wireless Local Area Network (WLAN) and, in particular, to modifications to the manner of frame transmission and acknowledgement in the current IEEE 802.11 Standards.

The IEEE 802.11 Standard specifies a Medium 10 Access Control (MAC) layer which, amongst other functions, manages access to a medium (i.e., a shared radio channel) by nodes in the WLAN such as WLAN clients or access points (APs). The 802.11 MAC layer uses an 802.11 physical (PHY) layer such as 802.11a 15 or 802.11b, to perform the tasks of carrier sending, transmission and receiving of 802.11 data.

Data in the 802.11 Standard is divided into frames, each of which contain, for example, timing and destination information in header portions (a MAC 20 Leader and a PLCP Leader), along with a data payload. Before the frames are transmitted, a station wishing to transmit must first gain access to the (shared) medium. Two forms of medium access are defined in the 802.11 Standard, Distributed Coordination Function 25 (DCF) and Point Coordination Function (PCF). DCF is mandatory and is based upon a carrier sense multiple access with collision avoidance (CSMA/CA) protocol. With DCF, 802.11 stations contend for access and attempt to send frames when there is no other station 30 transmitting. If another station is sending a frame, then stations wait until the channel is free.

There are various timing considerations in the 802.11 Standard. For example, stations accessing the network calculate the time necessary to send a frame (based upon the frame's length and the data rate) and 5 this information is held in the duration field of that frame's header, prior to transmission of the frame. Stations in the network maintain a Network Allocation Vector (NAV) which determines when a frame is sent by a given station. The duration fields of 10 received frames are examined by stations and these set that station's NAV.

In addition to the frame duration timing, the DCF also employs a random back-off timer which is used by a station when a busy medium is detected.

15 In the channel is in use, then a random delay is introduced before the station tries to access the medium again. This ensures that there is no repeated collision as would occur if multiple channels were repeatedly to check and attempt to access the medium 20 at the same time. The back-off timer significantly reduces the number of collisions, particularly when there are larger numbers of active stations.

WLAN stations cannot simultaneously listen for 25 collisions and transmit (mainly because a station cannot transmit and receive at the same time). To address this, an acknowledgement (ACK) must be sent by the receiving station once it has received the transmitted frame without errors. The receiving station waits for a short period known as a Short 30 Inter Frame Space (SIFS) before transmitting the ACK. The transmitting station assumes that there has been

a collision (or RF interference) if an ACK is not received within a specified time.

There are a number of problems with the present arrangement. The medium is not used during the SIFS period which follows receipt of the data frame by a receiving station. The medium also cannot be used for data transfer during the subsequent ACK transmission period. Furthermore, the use of a random back-off timer, whilst reducing the number of collisions, does mean that random delays can constitute a significant proportion of the available transmission time, causing a reduction in transmission capacity.

To address the problem of delays caused by the random back-off timer, 802.11 implementations have increasingly employed a technique known as "frame bursting". This is illustrated in Figure 1, which shows the transmission and reception channels 10, 20 of a first WLAN station, configured to process frames using frame bursting.

As is seen in Figure 1, the first WLAN station gains control of the medium, using the contention mechanism described above, after a random time introduced by the random back-off timer. A first data frame 30 is then transmitted. After a SIFS 40, an acknowledgement frame 50 for a previously transmitted data frame (not shown) is received in the reception channel 20. However, in this burst mode, instead of waiting a random time before sending a next data frame, the station instead starts transmission of that next data frame 60 immediately after a further SIFS 70. The station thus retains control of the

medium and other stations are in consequence prevented from starting transmissions until the burst has ended. The burst concludes when a maximum burst length is exceeded (to prevent one station from 5 controlling the medium indefinitely) or when the transmitting station runs out of frames to send.

Frame bursting thus reduces the amount of random time periods introduced in order to prevent collisions, although of course, it does not dispense 10 with them completely as a contentions mechanism is still necessary to decide which station will next have control of the medium following completion of a previous burst. However, frame bursting does still suffer from problems. In particular, a transmitting 15 station often runs out of frames to send in a given burst because the majority of data sessions are to some extent bi-directional. In other words, in order for a transmitting station to continue to have transmittable frames, it must first have received 20 return data (usually from the intended recipient station) in the reverse direction. As a result, frame bursts are often shorter than is desirable because the transmitting station runs out of frames to send.

The present invention is concerned with these 25 and other problems with current WLAN protocols.

Against this background, there is provided a method of handling data packets in a Wireless LAN network comprising: receiving, at a first node in the network, an incoming data packet from a second 30 node in the network; preparing an acknowledgement of receipt by the first node, for return to the second

node, when the incoming data packet is received at the first node; and when it is ascertained that there is at least one outgoing data packet at the first node and which is intended for transmission to that 5 second node, concatenating the acknowledgement of receipt with the or at least one of the outgoing data packets intended for that second node, for transmission as a combined data/acknowledgement packet to the second node.

10 In other words, the 'payload' data which is queued at the first node and is to be sent to the second node anyway is 'piggybacked' onto the acknowledgement of receipt which is usually (but not always) requested by the second node and which needs 15 to be sent by the first node. This provides an improved throughput of data relative to the prior art 'bursting' technique since payload data and acknowledgements of receipt can be sent simultaneously in certain circumstances.

20 The invention is particularly applicable to Transport Control Protocol/Internet Protocol (TCP/IP) traffic on a network. [why?]

25 The present invention may be put into practice in a number of ways and one specific embodiment will now be described by way of example only and with reference to the accompanying Figures in which:

Figure 1 shows how data is handled in the transmission and reception channels of a node in a wireless LAN, using conventional frame bursting 30 techniques; and

Figure 2 shows, schematically, how data is handled by the transmission and reception channels of first and second nodes in a wireless LAN, in accordance with an embodiment of the present invention.

Referring to Figure 2, the transmission channel 100 and reception channel 110 of a first node of a wireless LAN is shown schematically. Figure 2 also shows a transmission channel 200 and a reception channel 210 of a second node in that wireless LAN.

In accordance with an embodiment of the present invention, instead of sending separate acknowledgement and "payload" frames, "payload" data intended for transmission to a particular other node in the network is instead piggybacked onto an acknowledgement frame that needs to be sent to that particular node anyway as an acknowledgement of receipt for a data frame sent previously from that other node. A particular scheme for doing this will now be described, again by way of example only, still referring to Figure 2.

A first node receives a "standard" 802.11 data frame 120 with a PLCP head 130 from the second node in the network, after a random delay. The random delay is, as with the conventional frame bursting method, used as part of a contentious procedure for allowing a particular node, in this case, node 1, to gain control of the medium. As will be seen in Figure 2, the data frame received in the reception channel 110 from the second node is labelled data frame X.

Node 1, upon receipt of the data frame X 120 with its PLCP header 130 firstly checks to see whether node 2 has requested an acknowledgement of receipt of data frame X by node 1. Most, but not all, 5 data frames in the 802.11 Standard do require acknowledgement of receipt because of the risk of non-delivery through collision or RF interference. Once it has been determined that acknowledgement of receipt is required by node 2, node 1 next checks to 10 see whether there are any data frames queued for transmission, and which are intended for delivery to node 2. If there is at least one data frame, in this example labelled data frame Y, then node 1 concatenates the acknowledgement (ACK) frame 4 data 15 frame X 120 received from node 2 with that data frame Y which is intended for node 2. The PLCP header of data frame Y (which would, in the prior art, be a header to data frame Y) is not required; addressing and other details are included in the PLCP header of 20 the ACK frame instead.

Thus, a single, combined frame 140 is prepared for transmission by node 1. The combined frame 140 comprises a PLCP header 150, an acknowledgement frame 160 which acknowledges receipt of data frame X 120 from node 2, and a data frame Y 170 which is intended 25 for delivery to the second node. This is transmitted from node 1 after a SIFS following receipt of the data frame X 120 with PLCP header 130.

The combined frame 140 is transmitted across the 30 network and is received in the reception channel 210 of node 2. Node 2 recognizes that the frame 140 is a

combined frame (that is, a frame containing both an acknowledgement frame 160 for data frame X and also data frame Y 170, because the length of combined frame 140 is larger than that for a standard ACK 5 frame in the 802.11 Standard. Once the frame 140 has been recognized as a combined frame, the acknowledgement information from acknowledgement frame 160 can be extracted and handled in the usual manner, and data frame Y 170 can likewise be 10 extracted from the combined frame 140 again for onward passage in the usual manner.

It will be understood that, since most data frames require acknowledgement, mode 1 will in turn require acknowledgement of receipt of data frame Y 15 when it has been received by node 2. In this case, the procedure described above is repeated. In other words, once node 2 has determined that an acknowledgement of receipt for data frame Y is necessary, it checks to see whether there are any 20 queued data frames which need to be sent in the opposite direction, that is, back to node 1. When such a data frame, which for example is labelled data frame Z, is located in the queue at node 2, it is once again concatenated with the acknowledgement 25 frame for data frame Y so as to produce a second combined frame 180 made up of a PLCP header 190, an acknowledgement frame 192 for data frame Y received from node 1, and data frame Z 194 intended for transmission back to node 1. This further combined 30 frame 180 is transmitted from node 2 after a SIFS and is received in the reception channel 110 of node 1.

The procedure continues until there are no further data frames queued for a node requesting acknowledgement of receipt.

CLAIMS:

1. A method of handling data packets in a  
Wireless LAN network comprising:

5 receiving, at a first node in the network, an  
incoming data packet from a second node in the  
network;

10 preparing an acknowledgement of receipt by the  
first node, for return to the second node, when the  
incoming data packet is received at the first node;  
and

15 when it is ascertained that there is at least  
one outgoing data packet at the first node and which  
is intended for transmission to that second node,  
concatenating the acknowledgement of receipt with the  
or at least one of the outgoing data packets intended  
for that second node, for transmission as a combined  
data/acknowledgement packet to the second node.

20 2. The method of claim 1, wherein the  
acknowledgement of receipt comprises an IEEE 802.11  
acknowledgement (ACK) frame.

25 3. The method of claim 2, wherein the or each  
outgoing data packet includes an IEEE 802.11 data  
frame.

30 4. The method of claim 3, wherein the or each  
outgoing data packet, and the acknowledgement of  
receipt, each has a Physical Layer Convergence  
Procedure (PLCP) Header prior to concatenation, and

wherein the step of concatenating comprises concatenating the data frame part of the outgoing data packet(s), without the PLCP Header, with the said ACK frame and its associated PLCP Header.

5

5. The method of any preceding claim, further comprising:

transmitting the combined data/acknowledgement packet from the first node;

10 receiving the combined data/acknowledgement packet at the said second node; and

15 at that second node, extracting the from the received, combined packet, the data which had been held in the at least one outgoing data packet at the first node, and/or extracting the acknowledgement of receipt issued by the first node.

6. The method of claim 5, wherein the step of extracting is carried out when it is determined by 20 the said second node that the length of the combined data/acknowledgement packet is greater than that of an acknowledgement of receipt.

25

7. The method of claim 6, further comprising:

preparing, at the second node, a further acknowledgement of receipt of the combined data/acknowledgement packet at that second node; and 30 when it is ascertained that there is at least one outgoing data packet at the second node and which is intended for transmission to that second node, concatenating that further acknowledgement of receipt

with the, or at least one of the, outgoing data packets intended to be sent to the first node, for transmission as a further combined data/acknowledgement packet back to the first node.

5

8. The method of any of the preceding claims, wherein the acknowledgement of receipt by the first node is prepared and concatenated only when the second node requests such an acknowledgement.

10

9. A method of handling data packets in a WLAN substantially as hereinbefore described with reference to the accompanying drawings.

15

183998

20

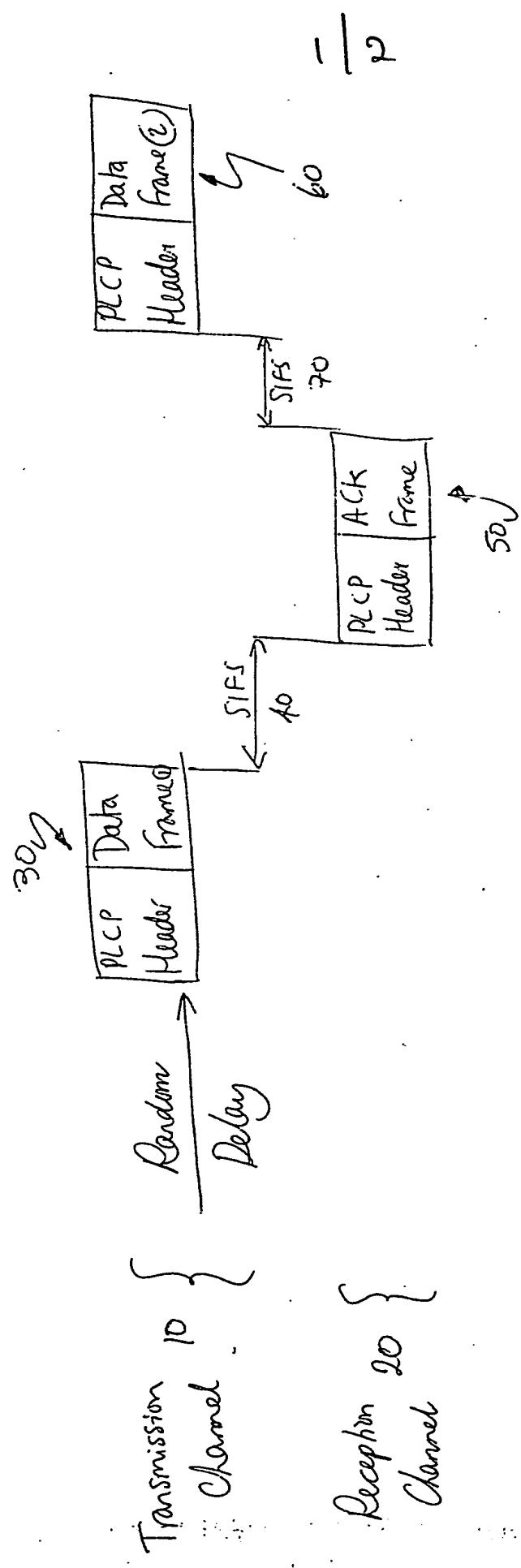
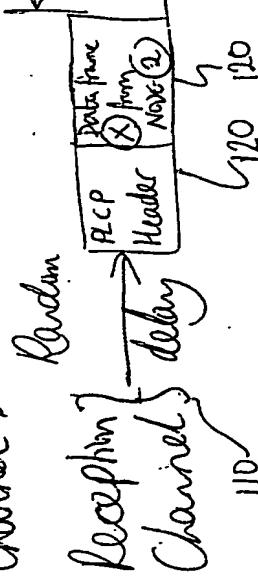


Fig. 1

PRIOR ACK

Node ① : Transmitting Channel



Node ② :

Transmission Channel

Reception Channel

210

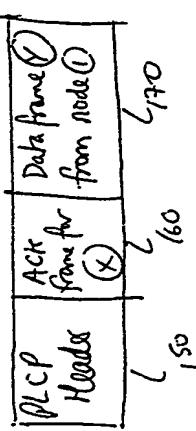


Fig. 2.

# Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/GB04/004026

International filing date: 22 September 2004 (22.09.2004)

Document type: Certified copy of priority document

Document details: Country/Office: GB  
Number: 0322132.2  
Filing date: 22 September 2003 (22.09.2003)

Date of receipt at the International Bureau: 25 November 2004 (25.11.2004)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)



World Intellectual Property Organization (WIPO) - Geneva, Switzerland  
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- BLACK BORDERS**
- IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- FADING TEXT OR DRAWING**
- BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- SKEWED/SLANTED IMAGES**
- COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- GRAY SCALE DOCUMENTS**
- LINES OR MARKS ON ORIGINAL DOCUMENT**
- REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**